2 of 3

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Contractor: Westinghouse Electric Corporation

Underseas Division

Contract No: DA-18-035-AMC-123(A)

FIRST QUARTERLY PROGRESS REPORT

COVERING THE PERIOD

April 1, 1964 thru June 30, 1964

WATER INTAKE AND RESUSCITATION EQUIPMENT FOR PROTECTIVE MASKS

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I. INTRODUCTION

The purpose of the contract is to develop low cost highly reliable equipment to be used in service protective masks which will allow the soldier in the field to drink water and to resuscitate battle field casualties while masked in a CB contaminated atmosphere. There is no such equipment in use at the present time, so that the specific design of the equipment will depend upon laboratory and field testing data obtained during the course of the program.

The program is divided into three phases:

1. Development - up to 3 models of three units each
2. Prototype - 6 units of best development model
3. Pre-production - 36 units of improved prototype

This report covers a portion of the first phase.

II. DEVELOPMENT AND FABRICATION

The development of water intake equipment under this contract was begun 1 April 1964. At that time Westinghouse (W) personnel met with persons from the Chemical Research Development Laboratories (CRDL) to review the work done by CRDL on this equipment.

Two designs have been investigated by CRDL. The first was the use of a probe attached to the canteen which could be inserted into the protective mask when the soldier desired water. The proposal for work under this contract was based upon this design. The greatest objection to this design was the relatively long time required to insert and remove the probe from the mask. During this time the soldier is so occupied with drinking that he is not capable of any offensive action, or even able to defend himself.

To reduce the amount of time required for drinking and thus better protect the man, a second design was developed. This device had a permanently mounted drinking tube inside the mask which extended through and outside the mask ending in a quick disconnect type coupling. The canteen had a flexible tube attached to it terminating in a quick disconnect type coupling that mates with the mask coupling. The tubing was long enough so that the canteen may stay on the wearers hip during the drinking process. Each coupling had a valve to prevent the entrance of contaminated air. When the canteen tubing was connected to the mask tubing, the valves were opened and water could be sucked up. In case of emergency, the connection could be quickly broken and since it was self-sealing, it provided complete protection for the man.

One problem with this design was that the mouthpiece was fixed and remained in the man's mouth all the time. Both Westinghouse and CRDL went to work to find a means of keeping the mouth piece out of the man's mouth, yet provide a means for getting it into his mouth when he desired to drink water or resuscitate.

Three approaches were investigated to provide a means for moving the mouth piece.

1. Attach a support for the flexible tubing to the nose cup so that by pressing on the mask nose the support moves the flexible tube and mouth piece into the man's mouth. The elasticity of the nose cup and mask retracts the mouth piece when the nose piece is released.
2. Attach the flexible tubing support to a shut-off valve mounted in the voice mitter assembly plate. When the spring loaded valve is pushed into the mask approximately 1/2 inch, the mouth piece moves into the man's mouth. Releasing the valve causes the mouth piece and flexible tubing to retract.
3. Moving the mouth piece and tubing into the mouth by means of a linkage mounted on the resuscitation check valve housing. The linkage is actuated by pulling the shut-off valve out approximately 7/32 inch. This moves the mouth piece into the man's mouth and opens the water passage. Releasing the shut-off valve shuts off the flow of water. In this design the mouth piece retraction is dependent upon the springiness of the flexible tubing. There is no positive means for retracting the mouth piece because for resuscitation it is necessary to have the mouth piece in the mouth yet have the shut-off valve closed.

Figure 1 - First Developmental Model Water Intake Equipment In Extended Position

Figure 2 - First Developmental Model Water Intake Equipment In Retracted Position

L-249

Figure 3 - First Developmental Model Water Intake Equipment Installed In Protective Mask

igure 4 - General View of Leakage Testing Equipment Showing Detector (Left) and Testing Chamber (Right)

L-248

It was agreed that the first development model scheduled for 1 June 1964 delivery would be based on the third approach. A photo of this model is shown by Figures 1 and 2. Figure 3 shows this model installed in a mask. The plastic canteen was used for this group of three units and was modified by the installation of a fitting in the canteen cap to which the tubing extending to the mask is attached. There is a short length of tubing with a weight on one end attached to the inside of this fitting. The tubing will be stowed in a pocket snapped to the outside of the canteen cover.

The first group of development models was fabricated chiefly from brass material by principally machining operations. Brass was selected because of its ease in fabrication. Soft wire was used to enable some adjustment of the parts during the testing and evaluation phases. The materials used for the later models will be selected to meet the expected service and environmental requirements, and be compatible with lowest cost production methods and processes.

The first three models were delivered to CRDL on 4 June 1964. These models were studied by human factors personnel and their comments on this design are:

1. The pulling action of the shut-off valve tends to break the mask to face seal by pulling the mask away from the face thus exposing the wearer to the contaminated atmosphere. To overcome this problem the valve should be redesigned to operate with a rotary motion instead of pulling action.
2. The inside diameter of the water tubing connecting the canteen and mask is too small, thus requiring too much time to drink the water. The

answer to this is to increase the minimum size of water passage from 3/32 inch diameter to 1/8 inch diameter.

3. There is or will be a tendency of the tubing that connects the canteen to the mask to kink or otherwise shut off the flow of water. Make the tube out of a material less subject to kinking or increase the wall thickness of the tubing or both to prevent kinking.

4. Some more thought should be given to the problem of storage of the tubing and its attachment to the canteen. The tubing should be attached to the canteen by means other than through the cap. This will allow use of the canteen in a normal manner without interference from the water drinking equipment. Another possible solution is to have the tubing separate from the canteen and be stored separately, then plugged into both the canteen and mask when desired to drink.

In answer to the first human factors objection, the design of the second development model will incorporate a shut-off valve using rotary action. Rotary motion of the valve will actuate the mouth piece through a pair of miter gears. Three units of this model are scheduled for delivery to CRDL on 1 August 1964.

DEVELOPMENT OF TEST EQUIPMENT AND TESTING

The models built under this contract are being tested by Westinghouse to insure that the introduction of the water intake equipment into the protective mask will not add to the mask leakage. The total leakage permitted during 5 attachments and detachments of the water tubing and mask is 5 parts per million (PPM) air. Additional testing such as vapor and particulate leakage tests

will be performed by the Government and these results will be used to determine future design.

The detection of leakage at such low rates presents a problem in finding a means of sufficient sensitivity so that such leakage may be measured. The Westinghouse Electronegative Gas Detector (EGAD) is of the required sensitivity and was used in the leakage testing. This detector uses the electron capture technique and is able to detect concentrations of gas as low as 1 part in 10 million. The sensitivity of the detector varies with the various gases and has a range from one part up to 100 parts per million. The gas used in this testing is Freon C-318 which the detector is most sensitive to. The EGAD has a meter which gives a direct reading of the concentration of the gas in parts per million.

The detector and test chamber fabrication is shown by Figure 4. The chamber actually consists of two chambers which may be called the detection chamber and freon chamber. In Figure 4, the detection chamber is shown on the left with the detector probe inserted. The clear plastic portion of the chamber is the freon chamber. Figure 5 shows the freon chamber which can be detached from the detection chamber in order to change cover plates on the detection chamber. There are two cover plates; one for testing voice mitter assemblies and the second with head form so that the mask and complete assembly may be tested. The head form is positioned upside down so that the masks can be placed on it easier. There is a fan in the detection chamber to prevent stratification and to insure good mixing. The two gloves shown in the freon chamber allow the water intake devices to be operated without reducing the

Figure 5 - Freon Chamber In Open Position Ready To Load Mask For Testing

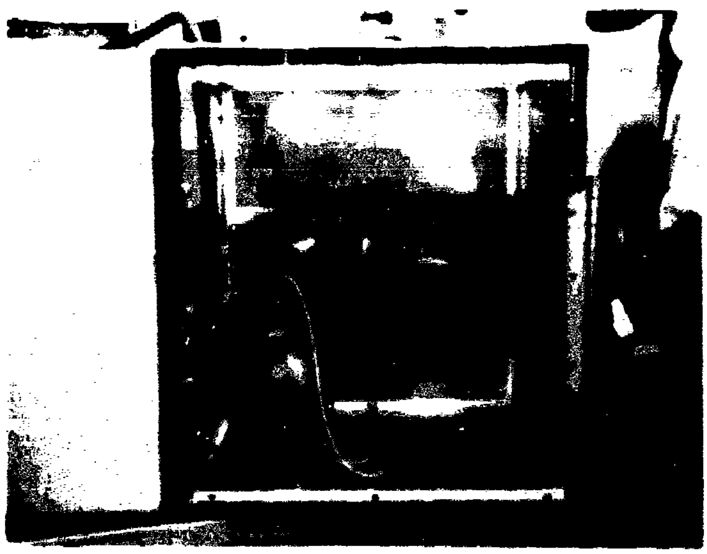

Figure 6 - Freon Chamber Closed, Mask On, Test In Progress. Shut Off Valve Being Operated

concentration of the freon in the chamber.

To test a voice mitter assembly or mask the proper cover is selected and attached to the detection chamber. The freon chamber is then secured to the detection chamber. Place the part to be tested in the freon chamber, shut the door and inject the proper quantity of Freon C-318 into the chamber. This is shown by Figure 6. The detection chamber pressure is reduced by 6 inches of water and held for the specified length of time. When ready to determine the leakage, the pressure is increased to atmospheric and the detector probe inserted into the detection chamber. This gives an indication on the meter of the number of parts per million freon in the detection chamber.

The leakage allowed by the contract is expressed as a rate of leakage whereas the leakage read by the detector is a static concentration. To correlate the two, the concentration of freon in the freon chamber must be specified. The allowable leakage of 5 PPM is equivalent to .05 cc per minute leakage. A concentration of 100 PPM is used in the freon chamber since this is the largest that can be checked by the EGAD. With this concentration of Freon, 0.01% of the mixture is Freon. If this is multiplied by the leakage rate of .05 cc per minute, the result is .0005% Freon should leak into the detection chamber per minute if the leak were the greatest allowable. This percentage is the same as 5 PPM so a concentration of 100 PPM in the freon chamber is equal to a reading on the EGAD of 5 PPM.

Another test made on the models was the simulated drinking test. A suction of 60 to 100 mm of mercury was applied to the water mouth piece. The water is

run into a graduated flask so that the volume of water moved through the system can be measured. A venting valve is added to the system to shut off the vacuum and open the drinking passage to ambient air pressure to break the vacuum occuring when water is removed from the sealed canteen and flow stops.

The test results of the three mask systems of the first development model are as follows:

LEAKAGE IN PARTS PER MILLION (PPM)

SYSTEM	1	2	3
VOICE MITTER ASSEMBLY (MODIFIED)	1.0	0.9	0.8
MASK *	3.0	3.4	3.2
MASK AND VOICE MITTER ASSEMBLY	3.8	4.5	4.0

* GFM M-17 Mask tested prior to replacing voicemitter with modified voicemitter.

The following information has been received from Government testing and evaluation of the first models.

1. The masks were tested in the gas chamber using CN gas and no leakage was noted.
2. Water was drunk satisfactorily through the mask while in the gas chamber.
3. A test of the resuscitation ability of the system was satisfactorily conducted.

4. It takes 14 minutes to empty a canteen full of water. The drinking rate for future models should be reduced to 10 minutes.

5. The exhalation resistance was somewhat higher than normal due to resistance of the resuscitation check valve.

6. The drinking tube was too long since it hit the wearers nose.

7. On two occasions the mask to face seal was broken by pulling too hard on the shut-off valve.

8. One unit had the wire that supports the bellows tubing come loose from the hub. The wire was re-soldered to the hub and testing continued.

9. On one system the drinking mouth piece came off the tubing and the resuscitation mouth piece came about half-way out of the bellows tubing after about 2 1/2 hours testing.

SCHEDULE

Development work during the next report period will be the production a model with a rotary actuation motion which corrects the inherent tendency of the pull type action to pull the mask off the wearers face.

The following are the scheduled delivery dates of the mask systems to be produced under this contract:

1. 1 August 1964 - the second group of development models consisting of three units.

2. 15 September 1964 - the group of 50 units of the Government approved first development model.

3. 1 October 1964 - the third group of development models consisting of three units.

4. 1 November 1964 - Prototype units of the selected development model consisting of 6 units.

5. 23 November 1964 - Pre-production models consisting of 50 units of the modified (if necessary) Prototype models.

The contract was modified on 30 June 1964 to add the fabrication of 50 additional assemblies which are to be the Government approved version of the first development model. These assemblies are scheduled for delivery by 15 September 1964.

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